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Abstract

Eighty-four crossbred gilts were used to examine the effects of increasing dietary additions of poultry fat (PF) or choice white grease (CWG) on longissimus muscle (LM), belly, and bacon quality. Pigs fed PF had greater LM cooking loss values than those fed CWG. As PF increased in the diet, LM Minolta L* and belly lean values decreased. then increased. Neither fat source nor level significantly affected other LM quality or sensory traits. As PF increased, bacon slicing score decreased. Although all taste panel scores were well within acceptable ranges, bacon from pigs fed PF had higher sensory panel "off flavor" scores than bacon from those fed CWG. These data indicate that PF and CWG can be added to finishing pig diets with minimal affects on LM, belly, and bacon quality.; Swine Day, Manhattan, KS, November 19, 1998

Keywords

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EFFECTS OF POULTRY FAT AND CHOICE WHITE GREASE ON PORK LONGISSIMUS MUSCLE, BELLY, AND BACON QUALITY [1]

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Summary

Eighty-four crossbred gilts were used to examine the effects of increasing dietary additions of poultry fat (PF) or choice white grease (CWG) on longissimus muscle (LM), belly, and bacon quality. Pigs fed PF had greater LM cooking loss values than those fed CWG. As PF increased in the diet, LM Minolta L* and belly lean values decreased, then increased. Neither fat source nor level significantly affected other LM quality or sensory traits. As PF increased, bacon-slicing score decreased. Although all taste panel scores were well within acceptable ranges, bacon from pigs fed PF had higher sensory panel "off flavor" scores than bacon from those fed CWG. These data indicate that PF and CWG can be added to finishing pig diets with minimal affects on LM, belly, and bacon quality.

(Key Words: Pork, Dietary Fat, Longissimus Muscle Quality.)

Introduction

Much research has been conducted to investigate the effects of dietary fat additions on finishing pig growth performance and carcass characteristics. Research from Kansas State University has indicated that increasing choice white grease (CWG) up to 6% of the diet did not affect growth performance or standard carcass characteristics of finishing pigs. However, the effects of alternative energy sources on longissimus muscle (LM), belly, and bacon quality of finishing pigs has not been examined. We know that differences in saturated and unsaturated fat depositions in pork carcasses can result from the source of dietary fat added to the finishing pig diet. Adding poultry fat (PF), a relatively unsaturated fat source, at high levels might have an negative influence on pork quality.

Therefore, the objective of this study was to compare the effects of increasing dietary PF or CWG on pork LM, belly, and bacon quality.

Procedures

Eighty-four crossbred gilts, (PIC L326 × C15, initially 133 lb) were used in this experiment. Choice white grease and PF were added at 2, 4, or 6% to a corn-soybean meal-based control diet (Table 1). Pigs were blocked by ancestry and allotted to one of seven dietary treatments.

The experimental control diet did not contain any added fat and was formulated to .75% lysine, .55% Ca, .50% P, and 2.26 g lysine/ Mcal ME. This lysine-calorie ratio was maintained in all of the diets containing PF or CWG and varied from .75 to .81%. The corn-soybean meal-based experimental diets were fed ad libitum in a meal form. The pigs were housed in an environmentally controlled finishing barn with 4 ft × 4 ft totally slatted pens. Each treatment included a pen with two pigs and six replicate pens.

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[1]The authors thank the U.S. Poultry & Egg Association for partial financial support.
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Individual fat sources were analyzed for their fatty acid profiles (Table 2). These profiles indicated that the percentages of palmitic fatty acids were very similar between the two fat sources. Palmitoleic and linoleic acid levels were almost double in PF as compared to CWG. Stearic acid levels were nearly double in CWG. Oleic acid levels were slightly higher in CWG than in PF.

Table 1. Basal Diet Composition[a]

Item	%
Corn	83.33
Soybean meal, 46.5%	14.07
Monocalcium phosphate	1.01
Limestone	.83
Salt	.35
L-Lysine HCl	.15
Vitamin premix	.15
Trace mineral premix	.10
Ethoxyquin	.01
Choice white grease[b]	- -
Poultry fat[b]	- -
Total	100.00

[a]Diets were formulated to 2.26 g lysine/Mcal ME, .60% Ca, and .50% P. Dietary lysine levels ranged from .75 to .81%.
[b]Choice white grease and poultry fat were added at 2, 4, or 6% to provide the experimental diets.

Both fat sources were analyzed using several key quality indicators (Table 3). Choice white grease tended to have a higher peroxide value. Nonetheless, this analysis revealed that both fat sources were of high quality.

Pigs were slaughtered at the Kansas State University Meats Laboratory when the mean weight of pigs in a pen reached 240 lb. At 24 hours postmortem, standard carcass measurements were taken. The carcasses were ribbed at the tenth rib and allowed to bloom for 30 minutes. At this time, the LM was evaluated by a three-person panel for visual quality characteristics including marbling, color, and firmness and wetness. Longissimus color was evaluated on a 1 to 5 scale with 1 representing a muscle that was pale-pinkish-gray, and 5 being a muscle that was dark-purplish red. Longissimus visual firmness and wetness were evaluated on a 1 to 5 scale, with 1 being very soft and watery and 5 being very firm and dry. Visual marbling was evaluated on a 1 to 5 scale, with 1 being practically devoid and 5 being moderately abundant or greater.

Table 2. Fatty Acid Profiles of Choice White Grease and Poultry Fat

Fatty Acid, %	PF	CWG
Palmitic (16:0)	22.2	23.3
Palmitoleic (16:1)	8.4	3.5
Stearic (18:0)	5.1	11.0
Oleic (18:1)	42.3	47.1
Linoleic (18:2)	19.3	11.0

Table 3. Fat Quality Indicators of Choice White Grease and Poultry Fat

Item	PF	CWG
Total fatty acids, %	98.7	97.9
Free fatty acids, %	3.2	3.2
M.I.U., %	1.3	.8
Peroxide value, mean/kg	.2	7.3

Following visual evaluations, the LM was traced to determine LM area. The LM and the subcutaneous fat surrounding the LM were evaluated with a Minolta Chromameter to obtain CIE L* a* b* values. Minolta L* values represent the lightness of a sample. Longissimus muscles with a higher L* value would have a lighter color, whereas those with a lower L* value would appear darker. Minolta a* values are chromatic coordinates representing a change from a green to a red color. A higher a* value represents a sample with more red color. Minolta b* values are also chromatic coordinates, representing a change in color from blue to yellow. The higher the b* value, the more yellow the color of the sample.

Longissimus samples were removed, and drip loss after 24 and 48 hours of suspension was evaluated. This evaluation was conducted by suspending the sample on a fishhook inside a sealed Tupperware container. The weight loss of each sample was collected and reported as a percentage of the original weight. Water holding capacity was determined by measuring the expressible fluid as a ratio of total fluid area to meat film area after a sample of the LM was placed between two pieces of filter paper and pressed using a hydraulic press.

A 12-member, trained, sensory panel analyzed cooked samples of the LM from pigs fed either the control diet or diets containing 6% CWG and PF. Samples were evaluated for myofibrilar tenderness, connective tissue amount, overall tenderness, juiciness, flavor intensity, and off flavors. Myofibrilar tenderness was scored on a scale from 1 = extremely tough to 8 = extremely tender. Connective tissue amount was evaluated on a scale of 1 = abundant to 8 = none. Overall tenderness was evaluated on a scale of 1 = extremely tough to 8 = extremely tender. Juiciness was evaluated on a scale of 1 = extremely dry to 8 = extremely juicy. Flavor intensity was evaluated on a scale of 1 = extremely bland to 8 = extremely intense. Off flavor was evaluated on a scale of 1 = extremely intense to 8 = none. LM samples were evaluated for tenderness using the Warner-Bratzler shear blade attachment on the Universal Instron Testing Machine.

In an effort to determine belly firmness, the belly, with the skin side down, was laid longitudinally over a metal bar. Measurements between the cut ends of the belly were made initially and after 10 minutes to determine the amount of droop occurring in each belly. Belly lean and fat L* a* and b* values were obtained on the cut surface of the belly using the same procedures used for measurement of the LM.

A portion of the belly was cured and processed into bacon. The bacon slices were scored for sliceability and hole scores. Slicability was evaluated on a scale of 1 = very soft and oily to 8 = very brittle and flaky. Hole scores were assessed by a scale of 1 = very high number of holes to 8 = no holes present. Cooked bacon samples were evaluated by a 12-member, trained, sensory panel for brittelness, flavor intensity, saltiness, and aftertastes. Brittleness was scored on a scale of 1 = extremely soft to 8 = extremely crisp. Flavor intensity was analyzed on a scale of 1 = extremely bland to 8 = extremely intense. Saltiness was analyzed on a scale of 1 = extremely salty to 8 = extremely unsalty. Off flavor was analyzed on a scale of 1 = none to 8 = extremely intense. Bacon samples were analyzed using the Warner-Bratzler shear force attachment on the Universal Instron Testing machine to assess toughness.

The data from this experiment were analyzed with the GLM procedure of SAS. Pigs were blocked by initial body weight. Hot carcass weight was used as a covariate with the individual pig as the experimental unit. Treatments were analyzed as a 2 × 3 factorial with control treatment. Treatment comparisons were made using orthogonal contrasts. Main effects of fat source (poultry fat or choice white grease) and fat level (2, 4, or 6%) were evaluated.

Results and Discussion

Increasing CWG tended to increase and then decrease LM visual color (quadratic, $P<.10$; Table 4). Visual color score of the LM increased for pigs fed 4% CWG compared to longissimus muscles from pigs fed 2% CWG. This represents a progression toward a darker color. As the level of CWG in the diet increased to 6%, the color score decreased, indicating a paler color. The firmness and wetness scores of LM from pigs fed PF and CWG showed a quadratic effect. As PF or CWG levels were increased to 4%, the firmness and wetness scores increased. This indicates a firmer, less exudative sample. The scores decreased at 6%, indicating a wetter, less firm sample. Increasing CWG decreased and then increased LM Minolta L* (quadratic, $P<.10$, Table 5). Sensory analysis of LM samples indicated no differences between pigs fed the control diet and those fed either 6% CWG or PF (Table 6). Increasing PF decreased, then increased belly lean Minolta a* values and b* values ($P<.05$). Increasing CWG increased and then decreased Minolta b* values (P<.05). As PF increased, bacon slicing scores decreased (Table 7). Bacon from pigs fed PF had higher sensory panel "off flavor" scores (P<.05) than bacon from those fed CWG. Slicing scores and off flavor scores for bacon from pigs fed PF were still within acceptable quality ranges. These data indicate that increasing levels of PF or CWG can be added to finishing pig diets with minimal influence on LM, belly, and bacon quality.

Table 4. Effects of Choice White Grease and Poultry Fat on Finishing Pig Carcass Characteristics and Subjective Evaluations[a]

		Choice White Grease, %			Poultry Fat, %			
Item	Control	2	4	6	2	4	6	CV
Backfat								
First rib	1.54	1.47	1.51	1.47	1.53	1.51	1.51	9.5
Tenth rib	0.79	0.74	0.81	0.78	0.80	0.78	0.76	18.6
Last rib	0.94	0.89	0.93	0.93	0.90	0.90	0.94	14.3
Last lumbar	0.77	0.67	0.80	0.75	0.78	0.77	0.81	18.6
Average[b]	1.08	1.01	1.08	1.05	1.07	1.06	1.09	9.7
LMA, in^2	6.64	6.87	6.51	6.72	6.57	6.17	6.69	11.4
NPPC								
Visual color[c]	2.50	2.57	2.67	2.34	2.46	2.46	2.45	16.1
Visual marbling[d]	2.61	2.44	2.56	2.33	2.40	2.53	2.20	26.4
Visual firmness[e]	2.86	2.83	3.02	2.80	2.66	2.81	2.66	16.2
Longissimus WHC								
Filter paper press, %[f]	37.04	36.77	38.96	36.69	35.83	38.68	37.32	13.4
Drip loss[g]								
24 hour, %	2.26	3.19	2.34	2.88	2.94	2.41	3.6	64.2
48 hour, %	3.91	4.98	3.94	4.57	4.58	3.67	4.81	54.6
Pork chop cook loss[ghi]	26.60	26.81	28.12	26.61	34.16	32.34	24.08	16.8
Pork chop shear force	4.13	4.14	4.06	4.21	3.99	4.99	4.14	32.6

[a]Means derived from 84 pigs (PIC, L326 × C15, initially 133 lb) slaughtered at 239 lb with six pens per treatment. Hot carcass weight was used as a covariant in the statistical analysis.
[b]Average backfat calculated as the average of first rib, last rib, and last lumbar fat depths.
[c]Scored on a scale of 1 = pale pinkish gray to 5 = dark purplish red (NPPC 1991).
[d]Scored on a scale of 1 = practically devoid to 5 = moderately abundant (NPPC, 1991).
[e]Scored on a scale of 1 = very soft and watery to 5 = very firm and dry (NPPC, 1991).
[f]Filter paper press percentage is derived by dividing the area of the meat by the area of the fluid after compression with the Carver Press.
[g]Expressed as a percentage loss of the original sample weight.
[h]Poultry fat vs choice white grease effect (P<.05).
[i]Poultry fat quadratic effect (P<.05).

Table 5. Effects of Choice White Grease and Poultry Fat on Longissimus Muscle and Belly Objective Color[a]

		Choice White Grease, %			Poultry Fat, %			
Item	Control	2	4	6	2	4	6	CV
Longissimus fat[b]								
Minolta L*[f]	77.76	77.70	77.28	77.16	77.74	77.52	76.54	1.70
Minolta a*	5.20	4.94	4.99	4.86	4.76	4.68	4.80	18.80
Minolta b*	5.88	5.86	5.88	5.79	5.76	5.92	5.87	11.30
Longissimus muscle[c]								
Minolta L*[g]	51.54	50.56	49.50	52.24	51.58	50.64	52.06	5.80
Minolta a*	11.45	12.10	11.00	11.19	11.52	11.85	13.00	18.40
Minolta b*	7.99	8.02	7.30	7.92	8.09	7.95	8.94	22.80
Belly fat[d]								
Minolta L*	79.48	79.54	79.61	80.26	79.47	79.57	79.90	2.60
Minolta a*	5.50	5.37	4.84	5.16	4.70	5.38	4.82	23.70
Minolta b*	6.24	6.22	5.80	6.07	5.94	6.50	6.04	12.80
Belly lean[e]								
Minolta L*	48.17	47.70	47.65	47.05	46.84	46.91	47.00	5.80
Minolta a*	22.35	19.81	20.69	20.12	19.94	19.91	21.23	11.50
Minolta b*[gh]	9.59	8.35	8.13	8.67	8.63	7.82	8.69	17.40

[a]Means derived from 84 pigs (PIC, L326 × C15, initially 133 lb) slaughtered at 239 lb with six pens per treatment. Hot carcass weight was used as a covariant in the statistical analysis.
[b]Means derived from two readings of fat surrounding the longissimus muscle.
[c]Means derived from two readings of the longissimus at the tenth rib.
[d]Means derived from two readings of fat at the tenth rib.
[e]Means derived from two readings of the longissimus at the tenth rib.
[F]Poultry fat effect, linear (P<.05).
[g]Choice white grease effect, quadratic (P<.05).
[h]Poultry fat effect, linear (P<.05).

Table 6. Effects of Choice White Grease and Poultry Fat (%) on Longissimus Muscle Sensory Characteristics[a]

Item	Control	Choice White Grease, %	Poultry Fat, %	CV
Flavor intensity[b]	5.75	5.68	5.67	2.70
Juiciness[c]	5.74	5.43	5.35	6.60
Overall tenderness[d]	6.15	6.23	6.34	12.50
Conn. tissue amount[e]	6.96	6.87	7.04	6.80
Myofibril tenderness[d]	6.02	6.04	6.12	13.70

[a]Means derived from 36 pigs (PIC, L326 × C15, initially 133 lb) slaughtered at 239 lb with six pens per treatment.
[b]Scored on a scale of 1 = extremely bland to 8 = extremely intense.
[c]Scored on a scale of 1 = extremely dry to 8 = extremely juicy.
[d]Scored on a scale of 1 = extremely tough to 8 extremely tender.
[e]Scored on a scale of 1 = abundant to 8 = none.
*No statistical differences.

Table 7. Effects of Choice White Grease and Poultry Fat on Belly Sensory, Texture, and Firmness Characteristics[a]

		Choice White Grease, %			Poultry Fat, %			
Item	Control	2	4	6	2	4	6	CV
Sensory[b]								
Aftertaste[c]	3.94	3.81	3.86	3.75	3.77	4.19	3.88	12.7
Off flavor[dj]	1.26	1.27	1.24	1.27	1.39	1.31	1.38	15.1
Saltiness[e]	5.11	5.01	4.85	4.88	4.82	4.96	4.83	6.6
Flavor intensity[dk]	5.60	5.39	5.33	5.30	5.32	5.44	5.39	5.2
Brittleness[f]	5.27	5.47	5.28	5.34	5.38	5.40	5.21	10.3
Bacon slicing score[gl]	3.94	3.26	3.24	3.32	3.66	3.50	3.06	27.2
Bacon hole score[h]	3.26	2.81	3.42	3.09	3.45	2.93	3.27	23.6
Bacon cooking loss[i]	37.3	36.12	36.19	35.5	34.94	37.09	35.59	11.6
Bacon shear force	5.95	5.38	5.48	5.84	5.83	5.99	5.90	27.40
Belly flexure test								
Initial	9.57	8.23	10.51	7.94	9.33	8.74	7.02	39.7
Ten minutes	7.63	6.49	8.36	6.42	6.74	6.86	5.44	39.3

[a]Means derived from 84 pigs (PIC, L326 × C15, initially 133 lb) slaughtered at 239 lb with six pens per treatment. Hot carcass weight was used as a covariant in the statistical analysis.
[b]Means derived from 12 panelists.
[c]Scored on a scale of 1 = none to 8 = extremely intense.
[d]Scored on a scale of 1 = extremely bland to 8 = extremely intense.
[e]Scored on a scale of 1 = extremely salty to 8 = extremely unsalty.
[f]Scored on a scale of 1 = extremely soft to 8 = extremely crisp.
[g]Scored on a scale of 1 = very soft and oily to 8 = very brittle and flaky.
[h]Scored on a scale of 1 = very high number of holes to 8 = no holes present.
[i]Expressed as a percentage loss of the original weight.
[j]Choice white grease vs poultry fat effect ($P<.05$).
[k]Choice white grease effect, linear ($P<.05$).
[l]Poultry fat effect, linear ($P<.05$).